

FINAL REPORT

Project Title: Hydrothermal Healing and Constitutive Behavior of Fault Gouge at Hydrothermal Conditions

USGS Award Number: 01HQGR0053

Recipient: Columbia University

Principal Investigator: Christopher Scholz
Lamont-Doherty Earth Observatory
Of Columbia University in the City of New York
61 Route 9W
Palisades, NY 10964

Telephone: 845-365-8360; Fax: 845-365-8150; E-mail: scholz@ldeo.columbia.edu

NEHRP Element(s): I

This project was an experimental study of the frictional properties of fault gouge under hydrothermal conditions. Two new mechanisms of fault healing were discovered during this project. The first such mechanism, described by Olson and Scholz (1998) involved the sealing and cementation of a quartzo-feldspathic gouge by the deposition of authogenic minerals produced by the reaction of the gouge with hydrothermal fluids. This mechanism produced not only fault healing (strengthening) but also permeability reduction within the gouge, thus providing a fault sealing mechanism.

The second mechanism, reported in Nakatani and Scholz (2003a,b) was found for pure quartz gouge, in which the above mechanism could not operate. This pronounced healing mechanism occurs only at elevated temperatures in the presence of liquid water, which distinguishes it from the healing mechanism observed at room temperature and which can occur in the presence of either the liquid or vapor phase of water. Its properties show it to be due to a solution transfer mechanism such as pressure solution.

One or both of these mechanisms are likely to be dominate under the hydrothermal conditions at seismogenic depth and hence are likely to be important in the earthquake instability process.

Publications

Olson, M.P., C.H. Scholz, and A. Leger, Healing and sealing of a simulated fault gouge under hydrothermal conditions: Implications for faulting, J. Geophys. Res. 103, 7421-7430, 1998.

Nakatani, M. And C.H. Scholz, Frictional heating of quartz gouge under hydrothermal conditions 1: experimental results. J. Geophysical Res. In revision, 2003.

Nakatani, M. And C.H. Scholz, Frictional heating of quartz gouge under hydrothermal

conditions 2, Theoretical analysis, J. Geophys. Res. In revision, 2003.